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1741C
Waveform Monitor

Service Manual

077-0155-02

Tektronix

1741C
Waveform Monitor

Service Manual

Warning
The servicing instructions are for use by qualified personnel only. To avoid personal injury, do not perform any servicing unless you are qualified to do so. Refer to all safety summaries prior to performing service.

Revision A

www.tektronix.com

077-0155-02

Tektronix

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- In North America, call 1-800-833-9200.
- Worldwide, visit www.tektronix.com to find contacts in your area.

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General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it.

To avoid potential hazards, use this product only as specified.

Only qualified personnel should perform service procedures.

While using this product, you may need to access other parts of a larger system. Read the safety sections of the other component manuals for warnings and cautions related to operating the system.

To Avoid Fire or Personal Injury

Use proper power cord. Use only the power cord specified for this product and certified for the country of use.

Ground the product. This product is grounded through the grounding conductor of the power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, ensure that the product is properly grounded.

Observe all terminal ratings. To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

Do not apply a potential to any terminal, including the common terminal, that exceeds the maximum rating of that terminal.

Power disconnect. The power cord disconnects the product from the power source. Do not block the power cord; it must remain accessible to the user at all times.

Do not operate without covers. Do not operate this product with covers or panels removed.

Do not operate with suspected failures. If you suspect that there is damage to this product, have it inspected by qualified service personnel.

Avoid exposed circuitry. Do not touch exposed connections and components when power is present.

Replace batteries properly. Replace batteries only with the specified type and rating.

Use proper fuse. Use only the fuse type and rating specified for this product.

Wear eye protection. Wear eye protection if exposure to high-intensity rays or laser radiation exists.

Do not operate in wet/damp conditions.

Do not operate in an explosive atmosphere.

Keep product surfaces clean and dry.

Provide proper ventilation. Refer to the manual's installation instructions for details on installing the product so it has proper ventilation.

Terms in This Manual

These terms may appear in this manual:

WARNING. *Warning statements identify conditions or practices that could result in injury or loss of life.*

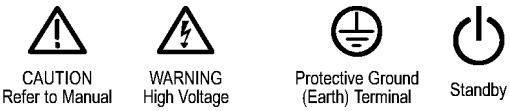
CAUTION. *Caution statements identify conditions or practices that could result in damage to this product or other property.*

Symbols and Terms on the Product

These terms may appear on the product:

- DANGER indicates an injury hazard immediately accessible as you read the marking.
- WARNING indicates an injury hazard not immediately accessible as you read the marking.
- CAUTION indicates a hazard to property including the product.

The following symbol(s) may appear on the product:



Service Safety Summary

Only qualified personnel should perform service procedures. Read this *Service Safety Summary* and the *General Safety Summary* before performing any service procedures.

Do Not Service Alone. Do not perform internal service or adjustments of this product unless another person capable of rendering first aid and resuscitation is present.

Disconnect Power. To avoid electric shock, switch off the instrument power, then disconnect the power cord from the mains power.

Use Care When Servicing With Power On. Dangerous voltages or currents may exist in this product. Disconnect power, remove battery (if applicable), and disconnect test leads before removing protective panels, soldering, or replacing components.

To avoid electric shock, do not touch exposed connections.

Preface

This manual supports servicing to the module level of the 1741C Waveform Monitor, which processes video signals for display on an internal XGA LCD. The instrument finds use as a monitor for broadcasting, production, and post-production environments.

This manual explains how to troubleshoot and service the monitor to the module level. The manual is divided into the following sections:

- *Introduction* provides a general product description and tells where to find product installation information.
- *Theory of Operation* provides descriptions of the 1741C Waveform Monitor modules.
- *Adjustment Procedures* details the adjustments that can be performed if the instrument is out of specification.
- *Maintenance* tells you how to troubleshoot the product to the module level and how to handle the modules.
- *Replaceable Parts* illustrates the replaceable modules and mechanical parts, and provides replacement part numbers.

Manual Conventions

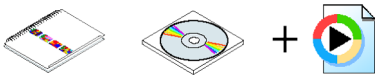
The following terms and conventions are used throughout this manual:

- The term “monitor” is used interchangeably with the more formal term “1741C Waveform Monitor.”
- The term “instrument” is used interchangeably with the term “monitor.”

Related Manuals

This manual assumes you have access to the following manuals when servicing this product. These manuals ship with the product and are also downloadable from the Tektronix Web site.

Table i: Related documentation

Item	Purpose	Location
1741C Waveform Monitor Quick Start User Manual	Installation and high-level operational overview	
1741C Waveform Monitor Specifications and Performance Verification	Procedure for checking performance and list of specifications	
1741C Master Information Base	Programmers command reference for controlling the waveform monitor	

Introduction

Introduction

The 1741C Waveform Monitor provides a powerful monitoring solution for broadcast, production, and post-production environments.

Service Strategy

The 1741C Waveform Monitors will be repaired to the module level at selected Tektronix service centers. Repair includes functional verification of the product. Component level repair by the customer is not supported.

Specifications

The specifications for this product are in the *Specifications and Performance Verification* manual, found on the *1741C Documents CD* that ships with the product. (See page x, *Related Manuals*.)

Performance Verification

The Performance Verification procedure for this product is in the *Specifications and Performance Verification* manual, found on the *1741C Documents CD* that ships with the product. (See page x, *Related Manuals*.)

Options and Accessories

The lists of options and accessories for this product are found in the *1741C Waveform Monitor Quick Start User Manual* that ships with the product. (See page x, *Related Manuals*.)

Configurations

At introduction there are no configuration options offered for the 1741C Waveform Monitor.

Hardware Installation

The waveform monitor is shipped in a wrap-around chassis which covers the instrument bottom and two sides. A cover is installed on the chassis, and the rear panel is made up of the module rear panel. You can operate the waveform monitor in the instrument chassis (the top cover must be installed, for safety and for proper cooling), or installed in an approved portable cabinet or rack adapter. You can also install the waveform monitor in a custom installation, such as a console. For installation instructions, refer to the *1741C Waveform Monitor Quick Start User Manual*.

Product Upgrade

To install product enhancements when ordered as a field upgrade, refer to the instructions included with the kit. Software is available at www.tek.com. The *1741C Waveform Monitor User Manual* also includes instructions for updating product software.

Operating Information

For basic operating instructions, refer to the *1741C Waveform Monitor User Manual* that shipped with this product.

Power-On Procedure

1. This product has no power switch; to power it up, plug it in to a line voltage source.
2. Wait for the system to complete its power-on self-tests.

Power-Down Procedure

There are two methods to power down the waveform monitor

Power Down – Unplug the instrument.

Standby – The instrument can be placed in a low-power standby mode by touching the **Standby** power button. This also saves the current instrument state as the Latest Preset, which can be configured as the Power-up Preset.

Theory of Operation

Theory of Operation

The 1741C is an Analog Composite waveform monitor with four input channels.

The monitor uses an internal XGA monitor for the display, and has an output to drive an external XGA monitor with the same display. It has outputs to drive serial digital and analog picture monitors.

This theory of operation is mainly based on the High-level Block diagram. (See Figure 2-1.) If necessary, other block diagrams may also be referenced.

The lower portion of the block diagram covers functions on the Main board. The upper sections cover those of the video input boards.

The primary functions on the Main board are:

1. Reference Input
2. Digital Waveform Processing Engine
3. Rasterizing Engine
4. Recursion and Picture processing Engine
5. Control Processor and it's associated peripherals
6. LTC decoder
7. Secondary Power supplies

There are also miscellaneous circuits, such as the thermal control system for the fan.

Power Distribution is not shown in the block diagram but is covered at the end of this section.

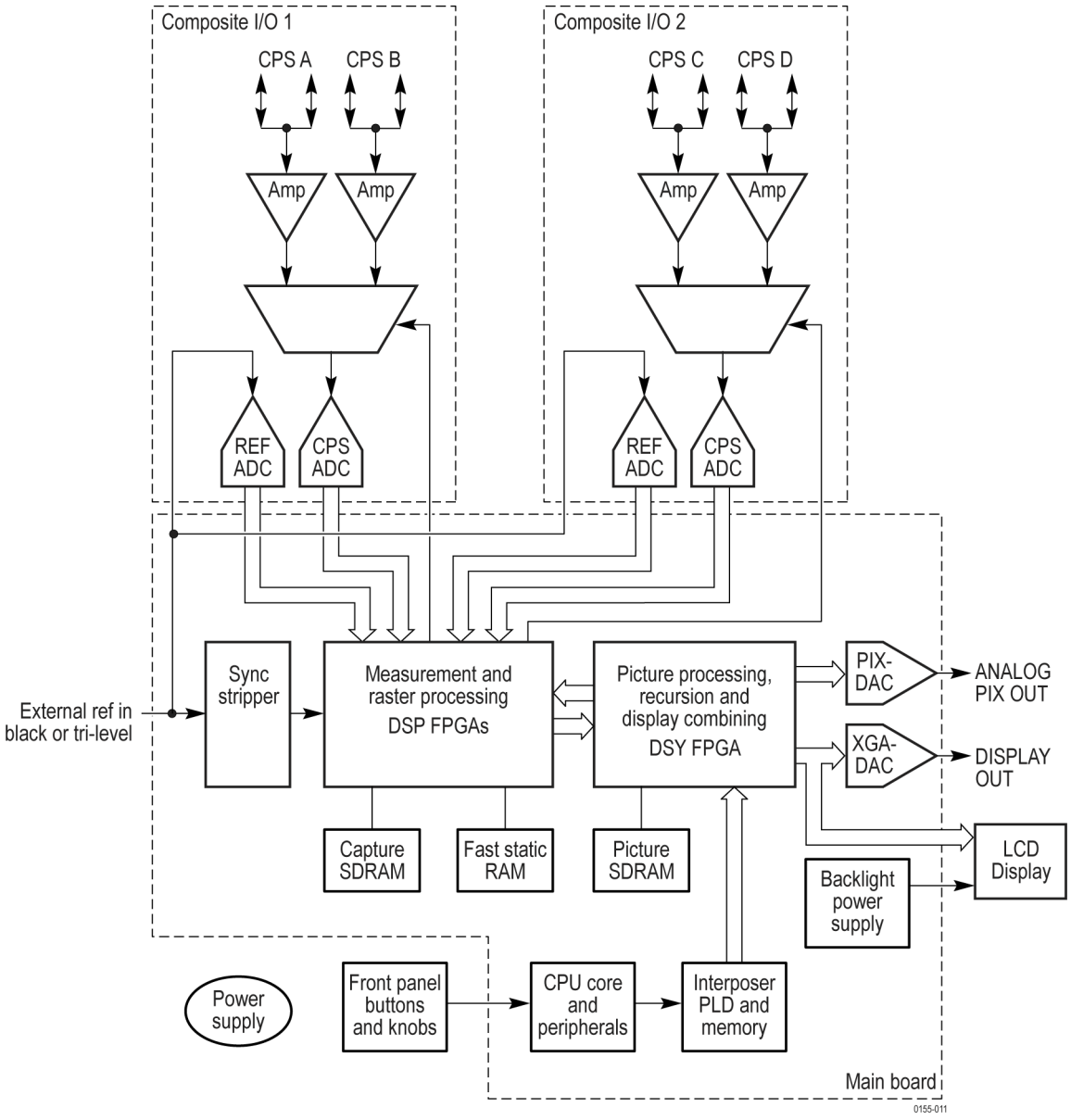


Figure 2-1: Main block diagram

Main Board

Reference Input

The Reference input is a passive loopthrough, which is AC coupled and buffered. The reference signal is routed to the composite input boards, where 10-bit ADCs digitize the signal. The digitized signal is then routed back to the DSP FPGA on the Main board so the timing information can be derived.

Digital Waveform Processing Engine

The parallel data streams from the Composite video inputs are applied to the waveform processing FPGA. This block processes the data to generate the signals needed to create the displays.

Rasterizing Engine

The Rasterizer engine resides in the same DSP FPGA as the waveform processing engine. This block builds up the variable intensity images in the fast static RAM. For each pixel of the display, the Rasterizer Engine increments the intensity of that pixel every time the waveform hits its coordinates. As a result the waveform areas hit more frequently are brighter. For any given frame, the intensity map is built up in one memory chip and read out of the other. The functions swap on the next field.

Recursion and Picture Processing Engine

The output of the rasterizer feeds the picture and recursive processing engine in the second large FPGA. This engine adds the previous frame to the present frame to reduce flicker and improve brightness. It also converts the picture and waveform signals from the input rate of 50 or 59.94 Hz to 60 Hz frame rate to work with the XGA monitor. The picture and waveform data combine with the graphics information from the control processor, and then output to the XGA DAC to drive the external monitor. Note that the parallel data from the serial digital inputs connect directly to this FPGA to provide the picture functionality, bypassing the waveform processing engine.

Control Processor

The control processor is in charge of all the operational modes in the instrument. It communicates with the front panel through SPI signaling, and controls most other internal devices though either the SPI or the I^2C bus. A few parts communicate through other bus types like JTAG or SPI.

The control processor interfaces to the Ethernet through a dual rate connection. This allows the network connection to run at 10 or 100 MBps.

LTC

LTC inputs come from the remote connector. The LTC signal is applied to an A/D converter and then input to the waveform processing FPGA, which decodes the time code information.

NOTE. *The FPGAs decode VITC signals digitally.*

Front Panel

The front panel contains a small processor which communicates with the control processor through SPI signaling. Reprogramming can be done through SPI as well, if the front panel processor flash code needs to be updated.

Composite Input

The waveform monitor contains two composite input boards, each of which contain two composite inputs. One board contains inputs A and B, and the other board contains inputs C and D. These are passive loopthrough inputs. If unterminated the signal appears twice as large as it should. The inputs on each board are either AC or DC coupled, depending on the DC Restore setting.

Input selection is done by a combination of settings stored in a selection register and a signal from the Measurement and Raster Processing block on the Main board. The selected input signal is filtered and applied to an A-to-D converter to generate a 14-bit parallel signal, which is routed to the DSP FPGA on the Main board, where it is demodulated in the digital domain.

The inputs are also routed to a synchronizing source switch, where the source is determined by a selection register. The selected synchronizing source is routed to a sync stripper whose output is sent to the Main board.

Fan Control

There are multiple temperature sensors in different locations in the instrument. The control processor reads the temperature sensors and sets a target speed for the fan. The fan circuit holds the fan speed at the target by measuring the fan tachometer output, allowing reliable operation at low speed. If the fan is not turning, the circuit senses the stall and turns on a red LED (DS861 on the Main board). The fan is tested at power up. If it fails, a message is shown on screen and also entered into the diagnostic log.

Power Supply and Distribution

The power supply has a universal AC input, enabling it to accommodate 100 to 240 V_{AC} without any user range switching. The output is 5 V_{DC}. Circuits convert this output to any other supply voltage that they require at the point of usage.

Fuses on the Primary supply 5 V output protect the Main board.

The secondary supplies and their tolerances are specified in the troubleshooting section. The location of the supply test points is shown in the *Maintenance* section.

Adjustment Procedures

Adjustments

The waveform monitor does not normally require any adjustments. The adjustments which can be made are semi-automated, and should only be made while performing a Performance Verification. Make the appropriate adjustment if the instrument fails one of these tests in the Performance Verification procedure:

- *PixMon Output Level*
- *Composite Analog Input DC Offset Restore Off*
- *Composite Analog Vertical Measurement Accuracy* or
- *Composite Analog Frequency Response*
- *Composite Analog Frequency Response* or
- *Channel Timing Match*

After making the adjustment shown here, repeat the failed Performance Verification step.

Required Equipment

The following equipment is required to complete all of the adjustment procedures.

Table 3-1: Required equipment for adjustment

Test Equipment	Requirements	Example
XGA Monitor	Computer monitor capable of 1024 x 768 x 60 Hz scan rate	
Video generator	• NTSC Black • NTSC 0% flat field • NTSC 100% color bars	Tektronix TG2000 with BG1 and AVG1 modules
	Precision calibration signals [1]	Tektronix part number 067-0465-00 (AVC1) module for TG2000 [2]
75 Ω coaxial cables (2 required)	General purpose digital video	Belden 8281
	Male-to-male BNC connectors 1 or 2 meters long	Tektronix part numbers 012-0159-00 or 012-0159-01
75 Ω Terminator (2 required)	Male connector, precision	Tektronix part number 011-0102-03
Test oscilloscope	>2 GHz bandwidth with 75 Ω input	Tektronix TDS7404B with TCA75 adapter
VGA to 5x BNC adapter cable	15 pin VGA connector input, 5 BNC connector outputs	Tektronix part number 174-5126-00
BNC splitter	1 female connector in, 2 male connectors out	

1 The required custom signals are provided on the User Documents CD. These signals are also provided for an AVG1 module, if an 067-0465-00 (AVC1) is not available. Download the PVCustomSignals.zip file, unzip it, and install the signals on your TG2000.

2 Note that the 067-0465-00 (AVC1) is not available outside of Tektronix. Other equipment can be substituted but it might not have sufficient accuracy to guarantee the specifications. For hum insertion, a general-purpose sine wave generator can be used to terminate and drive back into the video signal through appropriate impedance matching.

Procedures

PixMon

1. Connect a 100 IRE Flat Field video signal to the **Cmpst A** input. Terminate the loop-through in 75 Ω
2. Push **Input A** to select the Composite A signal.
3. Push the **CONFIG** button.
4. Use the arrow keys or the General knob to navigate to **Outputs** and set the **Composite Pixmon** to **On**.
5. Push the left arrow key to return to the first level of the **CONFIG** menu.
6. Connect an XGA to 5x BNC adapter cable to the PixMon output on the waveform monitor.
7. Connect the "Green" video signal to the oscilloscope input. Use an oscilloscope with a 75 Ω input, or use a 75 Ω feed through termination.
8. Set the Oscilloscope:

Control	Setting
Vert	200 mV/Div
Horiz	20 µs/Div
Trigger	Edge

9. Push the **Config** button.
10. Select **Utilities** > **Calibration**, and then push **SEL** to enter the calibration menu.
11. Navigate to the **Pixmon Composite Gain** case, and then push **SEL**.
12. Adjust the General Purpose knob to set the video portion of the signal to 714 mV (100 IRE).
13. Follow the instructions at the bottom of the screen to Save and Exit Calibration mode.

Composite Analog Input, DC Offset Restore Off

Perform the following steps if the Offset is outside the specification:

1. Push **Input A** to select the Composite A signal.
2. Push the **Config** button.
3. Select **Utilities** > **Calibration**, and then push **SEL** to enter the calibration menu.
4. Navigate to **Composite DC Offset** and push **SEL** to automatically adjust the offset.

5. Follow the instructions at the bottom of the screen to Save and Exit Calibration mode.
6. Push **Input C** to select the Composite C signal, and then repeat steps 2 through 5.

Composite Analog Vertical Measurement Accuracy

Perform the following steps if the Amplitude is outside the specification:

1. Connect a 100% color bar signal from the precision generator to the Composite A input. Terminate the loop through with a precision 75 Ω termination.
2. Push **Input A** to select the Composite A signal.
3. Push the **CONFIG** button.
4. Navigate to **Utilities** > **Calibration**, and then push **SEL**.
5. Select **Composite Waveform Gain**, and then push **SEL**.
6. Follow the on-screen instructions to adjust the gain.
7. Follow the instructions at the bottom of the screen to Save and Exit Calibration mode.
8. Move the 100% color bar signal to the Composite C input. Terminate the loop through with a precision 75 Ω termination.
9. Push **Input C** to select the Composite C signal, and then repeat steps 3 through 7.

Composite Analog Frequency Response

If the Frequency Response is outside the specification, follow this adjustment procedure:

1. Connect the precision generator to the Composite A input. Terminate the loop through with a precision 75 Ω termination.
2. Set the precision generator for a 700 mV Multiburst signal. The top packet must be 5.75 MHz.
3. Push the **CONFIG** button.
4. Navigate to **Utilities** > **Calibration**, and then push **SEL**.
5. Select **Composite Freq Peak** and then push **SEL**.
6. Follow the on-screen instructions to adjust the response.
7. Follow the instructions at the bottom of the screen to Save and Exit calibration mode.
8. Move the Multiburst signal to the Composite C input and terminate the loop through with a precision 75 Ω terminator.

9. Push **Input C** to select the Composite C signal, and then repeat steps 3 through 7.
10. Repeat the Composite Analog Frequency Response test in the Performance Verification procedure.

Composite Board 1 to Composite Board 2 timing

If the Channel Timing Match is outside the specification, follow this adjustment procedure:

1. Connect a 100% color bar signal from the precision generator to the **Composite A** and **Composite C** inputs, using the BNC splitter. Terminate both loop-through inputs with precision 75 Ω terminations.
2. Select **Multi Channel Mode**.
3. Enable both **Input A** and **Input C**, and select **Full Screen Vectors**.
4. Adjust the timing match to overlay the Channel C color bar vectors onto the Channel A color bar vectors.
5. Follow the instructions at the bottom of the screen to Save and Exit calibration mode.

This ends the adjustment procedure. To complete the process you should now perform a complete Performance Verification.

Maintenance

General Maintenance

This section contains the information needed to perform periodic and corrective maintenance on the waveform monitor. The following subsections are included:

- *Preventing ESD* – General information on preventing damage by electrostatic discharge.
- *Inspection and Cleaning* – Information and procedures for inspecting and cleaning the waveform monitor.
- *Troubleshooting* – Information for isolating and troubleshooting failed modules. Included are instructions for operating the waveform monitor diagnostic routines and troubleshooting trees. Most of the trees make use of the internal diagnostic routines to speed fault isolation to a module.
- *Removal and Replacement Procedures* – Information and procedures for removing and replacing modules in the instrument.
- *Repackaging Instructions* – Information on returning a waveform monitor for service.

Preventing ESD

Before servicing this product, read the *Safety Summary* and *Introduction* at the front of the manual, and the ESD information below.

CAUTION. *Static discharge can damage any semiconductor component in the waveform monitor.*

When performing any service that requires internal access to the waveform monitor, adhere to the following precautions to avoid damaging internal modules and their components due to electrostatic discharge (ESD).

1. Minimize handling of static-sensitive circuit boards and components.
2. Transport and store static-sensitive modules in their static protected containers or on a metal rail. Label any package that contains static-sensitive boards.
3. Discharge the static voltage from your body by wearing a grounded antistatic wrist strap while handling these modules. Service static-sensitive modules only at a static-free work station.
4. Nothing capable of generating or holding a static charge should be allowed on the work station surface.
5. Handle circuit boards by the edges when possible.

6. Do not slide the circuit boards over any surface.
7. Avoid handling circuit boards in areas that have a floor or work-surface covering capable of generating a static charge.

Inspection and Cleaning

Inspection and Cleaning describes how to inspect for dirt and damage. It also describes how to clean the exterior and interior of the waveform monitor. Inspection and cleaning are done as preventive maintenance. Preventive maintenance, when done regularly, may prevent waveform monitor malfunction and enhance its reliability.

Preventive maintenance consists of visually inspecting and cleaning the waveform monitor and using general care when operating it.

How often maintenance should be performed depends on the severity of the environment in which the waveform monitor is used. A proper time to perform preventive maintenance is just before any waveform monitor adjustment.

General Care

The cabinet helps keep dust out of the waveform monitor and should normally be in place when operating the waveform monitor.

WARNING. *To prevent injury or death, power down the instrument and disconnect it from line voltage before performing any procedure that follows.*

Interior Cleaning

Use a dry, low-velocity stream of air to clean the interior of the chassis. Use a soft-bristle, non-static-producing brush for cleaning around components. If you must use a liquid for minor interior cleaning, use a 75% isopropyl alcohol solution and rinse with deionized water.

Exterior Cleaning

Clean the exterior surfaces of the chassis with a dry lint-free cloth or a soft-bristle brush. If any dirt remains, use a cloth or swab dipped in a 75% isopropyl alcohol solution. Use a swab to clean narrow spaces around controls and connectors. Do not use abrasive compounds on any part of the instrument that may damaged by it.

CAUTION. *Avoid the use of chemical cleaning agents that might damage the plastics used in the waveform monitor. Use only deionized water when cleaning the front-panel buttons. Use a glass cleaner to clean the LCD. For the rest of the instrument, use a 75% isopropyl alcohol solution as a cleaner and rinse with deionized water. Before using any other type of cleaner, consult your Tektronix Service Center or representative.*

Inspection — Exterior. Inspect the outside of the waveform monitor for damage, wear, and missing parts, using the following table as a guide. Immediately repair defects that could cause personal injury or lead to further damage to the waveform monitor.

Table 4-1: External inspection check list

Item	Inspect for	Repair action
Cabinet, front panel, and cover	Cracks, scratches, deformations, damaged hardware	Repair or replace defective module
Front-panel knobs	Missing, damaged, or loose knobs	Repair or replace missing or defective knobs
Connectors	Broken shells, cracked insulation, and deformed contacts. Dirt in connectors	Repair or replace defective modules. Clear or wash out dirt
Carrying handle and cabinet feet	Correct operation	Repair or replace defective part
Accessories	Missing items or parts of items, bent pins, broken or frayed cables, and damaged connectors	Repair or replace damaged or missing items, frayed cables, and defective modules
LCD	Cracks	Replace the LCD assembly
	Dirty	Clean with glass cleaner

Inspection — Interior. To access the inside of the waveform monitor for inspection and cleaning, you will need to remove the top cover.

Inspect the internal portions of the waveform monitor for damage and wear, using Table 4-2 as a guide. Defects found should be repaired immediately.

If any circuit board is repaired or replaced, see if it is necessary to adjust the waveform monitor. (See Table 4-2 on page 4-3.)

CAUTION. *To prevent damage from electrical arcing, ensure that circuit boards and components are dry before applying power to the waveform monitor.*

Table 4-2: Internal inspection check list

Item	Inspect for	Repair action
Circuit boards	Loose, broken, or corroded solder connections. Burned circuit boards. Burned, broken, or cracked circuit-run plating.	Remove and replace damaged circuit board.
Resistors	Burned, cracked, broken, blistered condition.	Remove and replace damaged circuit board.

Table 4-2: Internal inspection check list (cont.)

Item	Inspect for	Repair action
Solder connections	Cold solder or rosin joints.	Resolder joint and clean with isopropyl alcohol.
Capacitors	Damaged or leaking cases. Corroded solder on leads or terminals.	Remove and replace damaged circuit board.
Wiring and cables	Loose plugs or connectors. Burned, broken, or frayed wiring.	Firmly seat connectors. Repair or replace modules with defective wires or cables.
Chassis	Dents, deformations, and damaged hardware.	Straighten, repair, or replace defective hardware.

Cleaning Procedure — Interior. To clean the waveform monitor interior, perform the following steps:

1. Blow off dust with dry, low-pressure, deionized air (approximately 9 psi).
2. Remove any remaining dust with a lint-free cloth dampened in isopropyl alcohol (75% solution) and rinse with warm deionized water. (A cotton-tipped applicator is useful for cleaning in narrow spaces and on circuit boards.)

STOP. If, after doing steps 1 and 2, a module is clean upon inspection, skip the remaining steps.

3. If steps 1 and 2 do not remove all the dust or dirt, the waveform monitor may be spray washed using a solution of 75% isopropyl alcohol by doing steps 4 through 6.
4. Gain access to the parts to be cleaned by removing easily accessible shields and panels.
5. Spray wash dirty parts with the isopropyl alcohol and wait 60 seconds for the majority of the alcohol to evaporate.
6. Dry all parts with low-pressure, deionized air.

Lubrication. There is no periodic lubrication required for the waveform monitor.

Troubleshooting

The procedures in this section will help you trace the root cause of a problem back to one of the replaceable modules. In general, this is a board-level replacement but there are a few components on some boards that are replaceable.

WARNING. *Before performing this or any other procedure in this manual, read the General Safety Summary and Service Safety Summary found at the beginning of this manual.*

To prevent possible injury to service personnel or damage to electrical component, refer on how to prevent ESD. (See page 4-1.).

Getting Started

This procedure consists of two main sections: the first section contains the *Symptoms and Causes* table, and the second section contains a set of *Detailed Troubleshooting Procedures*. The table lists common problems and should help you identify the problem or it may direct you to one of the detailed troubleshooting procedures in the second section. If you do not find your instrument's problem in the table, or if no specific problem was reported by the user, then follow the steps in the *Unknown Problem* section in the Symptoms and Causes table.

The 1741C waveform monitor is a complex instrument, and behavior is sometimes complex. Before troubleshooting in-depth, verify that the current settings support the expected behavior. A good first step is to recall the Factory Presets.

To properly test a waveform monitor you must have appropriate signal sources. For the 1741C you will need a Composite video source. In some cases, you may also need receivers or an oscilloscope to check outputs.

These instruments consist of several boards and major components. The objective of this troubleshooting guide is to isolate a problem to a module or board so it can be replaced. This guide does not provide information to troubleshoot to the component level.

Standard boards and modules:

- Power supply
- Display Assembly (LCD, Backlight inverter, Front Panel board with buttons, LEDs, and knobs
- Main board
- Composite input, boards 1 and 2

Table 4-3: Required test equipment

Test equipment	Requirements	Example
Video test generator with composite signal source.	Composite signals required: NTSC SMPTE bars	Tektronix TG2000 with AVG1 module
	Precision calibration signals	Tektronix part number 067-0465-00 calibration fixture for TG2000
XGA Monitor	Computer monitor capable of 1024 x 768 x 60 Hz scan rate	
Voltmeter		Fluke 87 or equivalent
DC Ammeter with Clamp on pickup	20 Amp DC capable	Fluke 336 or equivalent
Oscilloscope	Video trigger capability	Tektronix TDS3000C Series

Table 4-4: Symptoms and causes

Symptom	Possible Sources or Recommended Detailed Troubleshooting Procedure to follow
No LEDs lit and/or LCD not working	Perform general checks Perform primary power supply checks Perform secondary power supply checks Perform Front Panel button Troubleshooting Perform LCD troubleshooting test Replace Main circuit board or Front Panel assembly as indicated by above tests
Inconsistent or partial hardware failures	Perform primary power supply checks Perform secondary power supply checks Examine Power-up Diagnostics results in the Diagnostic Log Run Advanced Diagnostics Replace Main circuit board
Fails any of these Power On Diagnostics: ■ Main Board Power Supplies ■ Main Board Sensor ■ Main Board Serial EEPROM ■ Main Board Serial FLASH ■ DSP FPGA A/B COMM ■ DSP FPGA A/B Program ■ Display FPGA COMM ■ Display FPGA Program	Review messages in diagnostic log Perform primary power supply checks Perform secondary power supply checks Run Advanced Diagnostics and look for other information Replace the Main board

Table 4-4: Symptoms and causes (cont.)

Symptom	Possible Sources or Recommended Detailed Troubleshooting Procedure to follow
Fails any of these Power On Diagnostics: ■ Composite DAC Comm: ■ Composite SPI Comm: ■ Front Panel Version Information	Review messages in diagnostic log Perform primary power supply checks Perform secondary power supply checks Run Advanced Diagnostics and look for other information Replace the Composite board
Failures while running the advanced diagnostics: ■ Display Data Bus ■ Display Address Bus ■ Raster Data Bus Input ■ DSP1 Data Bus ■ DSP1 Address Bus ■ DSP2 Data Bus ■ DSP2 Address Bus ■ DSP1 QDR1 ■ DSP1 QDR2 ■ DSP2 QDR1 ■ DSP2 QDR2 ■ RD SDRAM Data ■ RD SDRAM Address ■ DSP1 SDRAM Data Bus ■ DSP1 SDRAM Address Bus ■ DSP2 SDRAM Data Bus ■ DSP2 SDRAM Address Bus	Perform secondary power supply checks Replace Main board

Table 4-4: Symptoms and causes (cont.)

Symptom	Possible Sources or Recommended Detailed Troubleshooting Procedure to follow
Failures while running the advanced diagnostics (cont.): ■ DSY → DSP1 Bus Output ■ DSY → DSP1 Bus Input ■ DSP1 → DSY Bus Output ■ DSP1 → DSY Bus Input ■ DSY → DSP2 Bus Output ■ DSY → DSP2 Bus Input ■ DSP2 → DSY Bus Output ■ DSP2 → DSY Bus Input ■ DSP1 → DSP2 Bus Output ■ DSP1 → DSP2 Bus Input ■ DSP2 → DSP1 Bus Output ■ DSP2 → DSP1 Bus Input	Perform secondary power supply checks Replace Main board
Failures while running the advanced diagnostics (cont.): ■ Cmpst Mux Select ■ Cmpst DC Rest Ctrl ■ Cmpst Ref Mux Sel ■ Cmpst Ref Clk Sel ■ Display Cmpst Ctrls ■ DSP1 Cpmst Tests ■ DSP2 Cpmst Tests	Review messages in diagnostic log Perform primary power supply checks Perform secondary power supply checks Run Advanced Diagnostics and look for other information Replace the Composite board
No text or traces on LCD	Perform LCD troubleshooting test
Traces on LCD but not on Ext Display output	Replace Main board

Table 4-4: Symptoms and causes (cont.)

Symptom	Possible Sources or Recommended Detailed Troubleshooting Procedure to follow
Functional Test Failures Performance Verification Test Failures	In case of failure on either Functional or the Performance tests, the board at fault is generally obvious. Before replacing a board: 1. Perform the primary and secondary power supply checks. 2. Run the advanced diagnostics and check the diagnostic log for help in isolating the fault. If this does not isolate the problem, then replace the Main board if the test is in one of the following areas: ■ Composite ■ Ref ■ LTC ■ XGA output ■ Color Palette ■ Remote I/O ■ Ethernet If the problem is Composite, replace the composite board. If the problem persists then replace the Main board.
Unknown Problems An instrument may come into service with vague or intermittent symptoms. In a case like this, the following set of tests may help find the problem or the marginal condition.	1. Check the diagnostic log. This log records a variety of problems and will enable you to see messages for an error that may not be currently happening. 2. Check the power supplies by performing the Primary and Secondary Supply checks. A marginal supply can lead to intermittent operation if it is near the acceptable threshold. This includes the main supply and the secondary supplies on each board. 3. Check the error log. This may give clues about how the unit was operating when the user saw problems. 4. Perform the incoming inspection tests. This will exercise a majority of the functions in the unit and includes the advanced diagnostics. Some parts of the test may not be necessary for all problem areas.

Detailed Troubleshooting Procedures

The following tests should be run as indicated in the *Symptom and Causes* table. (See Table 4-4 on page 4-6.). The procedures check for specific problems or will help you isolate a problem to a board. You can run them at any time for informational purposes but if you do not run the procedures in the correct context, then the final recommendation identifying a root cause might be suspect.

List of detailed troubleshooting procedures:

- General Checks
- Primary Power Supply Checks
- Secondary Power Supplies Checks

- Front Panel Troubleshooting
- Isolating Advanced Diagnostic Errors

General Checks

1. Verify that the power cord is connected.
2. Check that all internal cables are correctly connected and seated.
3. Check for any discolored or burned components.

Fan Failures

The Fan is controlled by both hardware and software. Hardware controls the fan to a certain speed, but software sets the speed target as a function of the temperature measured on a variety of temperature sensors.

If the fan fails, then LED DS861 on the Main board will be lit.

The fan failure is sensed through tachometer feedback, thus a fault will be asserted if the fan is not connected, is stalled, or if the tachometer feedback line is not working correctly.

If the fan fails, the control circuit will increase the voltage to the 13.5 V max level.

The normal voltage to drive the fans (pin 1) varies from about 6 V to 13.5 V in response to temperature and fan speed.

If the fan is not spinning, measure the voltage on the fan connector J890 pin 1. If the voltage is near 13 V then replace the fan.

If the voltage is not above 10 V then replace the Main board.

If the fan is spinning, but LED DS861 is lit, the problem is probably the tachometer feedback line on pin 3 of the fan. Inspect the wiring and pull-up resistor R864 on the Main board, and use the oscilloscope to look for a 3.3 V square wave on the tachometer feedback line. Replace the fan if the pull up is intact but there is no signal on the tachometer line

Primary Power Supply Tests

This section describes methods for verifying the proper operation of the waveform monitor primary power supply.

WARNING. *Some parts of this test may require removing the insulating safety shield. To avoid personal injury, be careful not to contact the circuitry while the shield is removed. Be sure to replace the shield as soon as possible to prevent injury.*

The main power supply accepts 100 to 240 V_{AC} and outputs 5 V_{DC}. The output voltage at the supply must be between 4.9 and 5.3 V for correct operation. On the Main board, the common 5 V supply must be between 4.80 and 5.25 V.

There is also a green LED, DS232, that will be lit if some 5 V power is present. This is a useful indicator, but does not insure that the voltage is within tolerance.

If the power supply output is correct, check the seven fuses in the 5 V system near the Main board power connector J14. (See Figure 4-1 on page 4-15.). All should have 5 V on both sides. If not, replace the fuse. See the Replaceable Parts List for fuse values. (See Table 5-3.)

CAUTION. *Replace a fuse only with a fuse of the same type and rating. Failure to do so can result in improper operation, and could cause a fire.*

If the supply output voltage is zero, then check the input circuit. The voltage should be the same at the line cord, at the input to the power supply, and on both ends of the fuse on the input to the supply. If the input voltage is correct while the output is not, replace the supply. If the input voltage is not correct replace the element in the chain that is not passing the AC input.

If the voltage at the output of the supply is not zero, but still not correct, check the input voltage. If the input voltage is in the correct range, then disconnect the output of the supply from the Main board and recheck the output voltage. If the voltage is still not correct then replace the power supply.

If the no-load output voltage is correct, then reattach the cable to the Main board and measure the current by clamping the ammeter around all the red wires. If the current is less than 14 Amps, and the voltage is still bad, then replace the power supply. If the current is more than 14 Amps, then remove module boards and recheck the current. If it is still high then replace the Main board. If not then test with one option board at a time to find the one with excess current and replace that board.

Secondary Power Supply Tests

There are multiple secondary supplies that are derived from the main 5 V supply. Be sure all seven 5 V fuses are good (as noted in *Primary Power Supply Tests*) before checking the secondary supplies.

First, check the LEDs near the power connector, J14. Green LED DS232 indicates there is some 5 V from the main supply.

Next, check if any of the three Red LEDs (DS231, DS321, or DS761) are on. These indicate failures on the General 5 V, processor core 1.3 V, and general 3.3 V supplies respectively. If these are lit the most likely causes are the fuses near J14, but if those are all OK replace the Main board.

Next, check the secondary supplies as shown in Table 4-5. Each supply has a test point in the front left corner of the Main board. (See Figure 4-1 on page 4-15.) If any supplies are out of range, replace the Main board.

Table 4-5: Main board secondary supplies

Nominal (+V)	Allowed range (+V)	Measure at
1.8	1.7 to 1.9	TP29
Fan	5 to 13.5	TP24
+5	4.75 to 5.25	TP27
3.3	3.2 to 3.4	TP31
2.5	2.4 to 2.6	TP33
1.5	1.4 to 1.6	TP35
+5A	4.75 to 5.25	TP36
-5A	-4.75 to -5.25	TP39
1.3 Core	1.2 to 1.4	TP30

Front Panel Button Troubleshooting

Perform this test if the power supplies are good, but none of the buttons are lit or respond to pushes.

1. Cycle the power to the unit. Immediately after power up three buttons (MAG, LINE SEL, and CURSOR) should be lit continuously, and the other buttons should be lit one at a time in a walking pattern.
2. If the buttons are not lit, check the 10 pin cable from the keypad to the Main board J29. If the cable is connected and good then replace the front panel assembly.

LCD Troubleshooting

Perform this test if there is no display on the LCD, but the power supplies test as nominal.

1. Connect an external XGA monitor to the “Display” output on the rear of the instrument.
2. Cycle the power and watch the external monitor. If the monitor does not display the boot up messages and normal operational screen replace the Main board.
3. If the external monitor does show the nominal screen, check the gray ribbon cable from the internal display to J17 on the Main board. This carries the XGA data to the display.
4. If the gray ribbon cable is OK, look at an angle into the gap at the left edge of the LCD, turn the power off and on and you should be able to see the backlight come on. It may help to be in a low light area to see the backlight.

5. If the backlight is on replace the front panel assembly.
6. If the backlight is not on, check the backlight power cable from the backlight inverter (on the rear of the display assembly) to the Main board J18. Also check connector J18 itself for any solder issues.
7. If the backlight is still bad, replace the front panel assembly — although there is still a small chance the problem is in the Main board.

Examine Power-Up Diagnostics Results in the Diagnostic Log

To examine the Power-up Diagnostics results, push the **CONFIG** button, then select **Utilities** > **View Diagnostic Log**.

Each power up is indicated by a boot time stamp, followed by a list of power on tests. If any failures are indicted then refer to the action as noted above.

Run Advanced Diagnostics

To run the Advanced diagnostics, push the **CONFIG** button, then select **Utilities** > **Run Advanced Diags**.

A series of tests will be run; the exact tests will depend on which options are present in the instrument. There are four distinct parts to the advanced diagnostic results screen: a top section which shows Frequencies and Versions, a middle section of Pass/Fail tests, a lower section which shows SDI and Video bus activity, and, finally, narrow YRGB ramps at the very top and bottom to look for missing bits on the display interconnect.

Frequencies are shown in the Top Section — read carefully! These tests do not show a pass/fail result, even if zero. Measurements are relative to the 25 MHz VGA clock. Refer to Table below to see the limits for the frequencies. (See Table 4-6.)

The Middle section shows pass/fail tests. These are mainly bus tests between FPGAs, Memory, CPU, etc. Some tests cover busses from an option board to the Main board. In this case it is difficult to tell which end is at fault. Generally there will be multiple failures, so the most likely cause is evident. If not, the best path may be to replace the option card first. If that does not fix the problem then replace the Main board.

The last section of the Advanced Diagnostic Screen are the color ramps at the top and bottom of the screen. These can be used to check the bits provided to the LCD. If any bits are missing then you will see banding in the ramps. It is normal to see some bands about $^1/_8$ inch (2 mm) wide, especially near the lower intensity regions of the ramp. This is because the LCD is only 6 bits, so there are 64 steps in the ramp. However, any larger steps or any non-monotonic regions indicate a problem. Check the cable to the LCD, perform the LCD diagnostic procedure, or replace the display assembly. It is also possible for the Main board to cause problems in this area.

Table 4-6: Advanced diagnostic measurements

Measurement	Min	Max
VGA Clock	64.4375 MHz	64.4575 MHz
QDR Clock	25.1650 MHz	25.1850 MHz
HSYNC PW	20.4 µs	20.8 µs
VSYNC PW	18974.9 µs	19174.9 µs

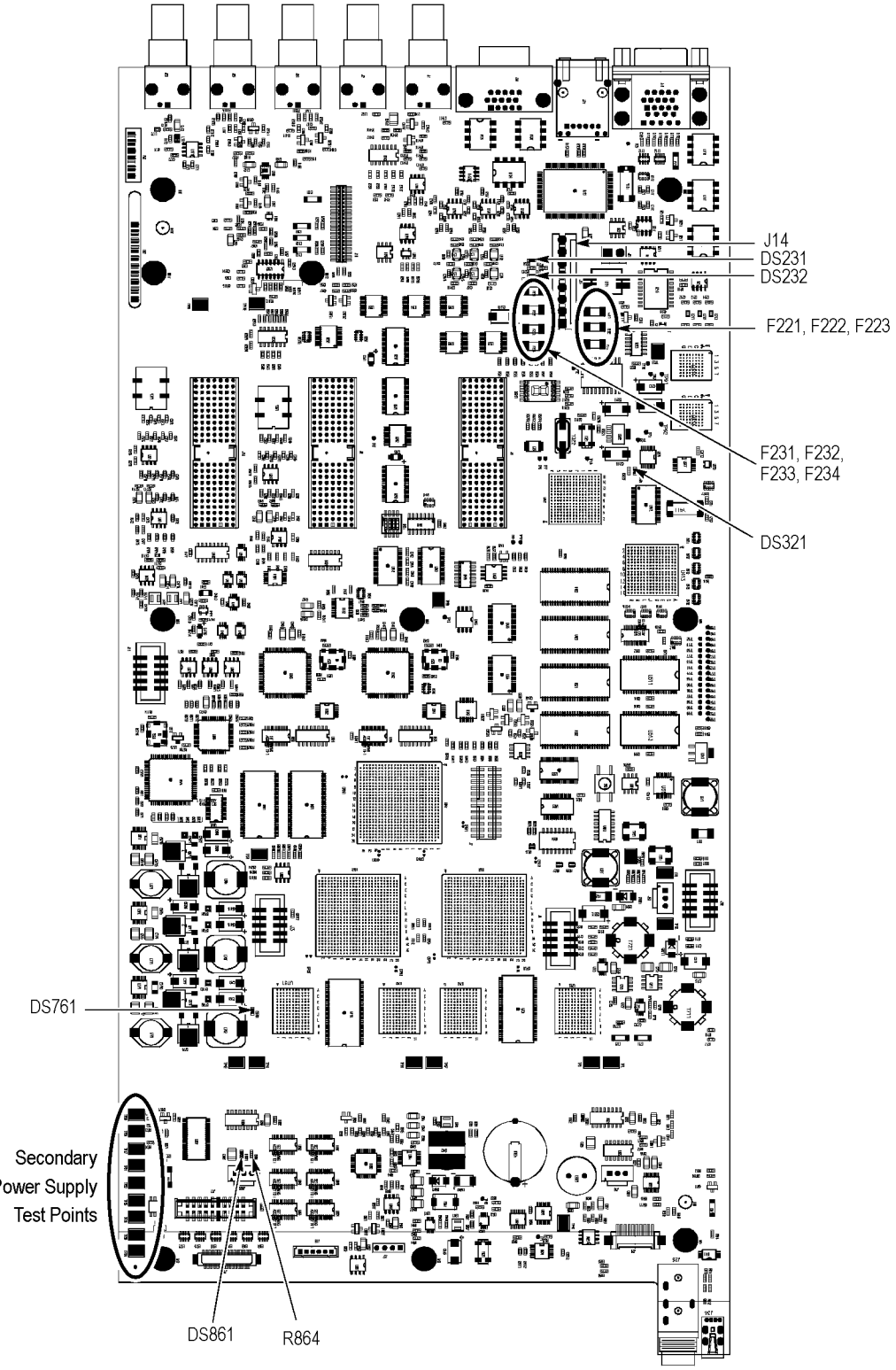


Figure 4-1: Main board power supply test points and LEDs

Removal and Replacement Procedures

This section contains information about removal and replacement of all modules in the waveform monitor.

Preparation

WARNING. *Before doing this or any other procedure in this manual, read the safety summaries found at the beginning of this manual. Also, to prevent possible injury to service personnel or damage to the instrument components, read Installation in Section 2, and Preventing ESD in this section.*

This subsection contains the following items:

- This preparatory information that you need to properly do the procedures that follow.
- List of tools required to remove and disassemble all modules.
- Procedures for removal and reinstallation of the modules.

WARNING. *Before doing any procedure in this subsection, disconnect the power cord from the line voltage source. Failure to do so could cause serious injury or death.*

NOTE. *Read Equipment Required for a list of the tools needed to remove and install modules in this instrument. (See Table 4-7 on page 4-16.) Read the cleaning procedure before disassembling the instrument for cleaning.*

Equipment Required. Most modules in the instrument can be removed with a screwdriver handle mounted with a size T10, TORX screwdriver tip. All equipment required to remove and reinstall the modules is listed in the following table. (See Table 4-7 on page 4-16.)

Table 4-7: Tools required for module removal

Item no.	Name	Description	General Tool number
1	Torque driver handle	Accepts 1/4 inch hex bits	620-440
2	T10 TORX tip	Used for removing most instrument screws. TORX-driver bit for T10 size screw heads	640-235

Table 4-7: Tools required for module removal (cont.)

Item no.	Name	Description	General Tool number
3	T15 TORX tip	Used for removing instrument screws. TORX-driver bit for T15 size screw heads	640-247
4	P1 Pozidriv tip	Used for removing P1 bezel screws	Standard tool
5	1/8 inch flat-bladed screwdriver	Screwdriver for unlocking cable connectors	Standard tool
6	Angle-Tip Tweezers	Used to remove front panel knobs	Standard tool
7	3/16 inch nut driver	Used to remove jack screws and front panel standoffs	Standard tool
8	5/16 inch nut driver	Used to remove nut on AC ground lug	Standard tool
9	9/16 inch deep socket	Used to remove rear panel BNC nuts	Standard tool
10	MA-800G Soldering Aid (spudger)	Used to remove the front panel trim	Standard tool
11	Soldering iron (15 W)	Used for replacing Main board fuses	Standard tool
12	Long nose pliers	Used to compress connector lock tabs	Standard tool

Module Removal

The removal of most of the modules is a straightforward process, and can be determined by a quick study of the exploded diagrams in the *Replaceable Parts List* in Section 5. The table below shows what to remove to access each module. (See Table 4-8 on page 4-17.)

Table 4-8: Module removal

	To remove				
You must first remove	Composite	Power supply	Main	Front panel	LCD assy
Top cover	X	X	X	X	X
Board supports	X	X	X		
Composite boards			X		
Main board					
Power supply			X		
Fan assembly			X		
Front panel			X		X
LCD assembly			X	X	

Top Cover

The top cover is a slip-lock design.

1. Remove the two T10 screws at the top cover front corners.
2. Remove the four T10 screws securing the top cover to the rear panel.
3. Slide the top cover back approximately ½ inch and then lift it from the chassis.

Board Supports

The board supports span across the instrument, holding the tops of the module circuit boards in place.

1. Remove the two T10 screws securing each board support, and then lift them from the chassis. When reinstalling, torque these screws to 8 in/lb.
2. When reinstalling the board supports, make sure that the module circuit boards line up with the slots in the board supports.

Rear Panel

The rear panel is formed by the chassis and the Composite module rear panel, which overlap and are bolted together.

Composite Boards

Follow this procedure to remove the Composite boards:

1. Remove the six T15 screws securing the Composite module to the rear panel. When reinstalling, torque these screws to 8 in/lb.
2. Lift the Composite module out of the instrument, rocking it gently until the connectors separate from J9 and J13 on the Main board.
3. For the Composite board you are removing, use the $^{9}/_{16}$ inch socket to remove the nuts attaching the BNC's to the rear panel. When reassembling, torque these nuts to 10 in-lb.

Power Supply

1. Disconnect the brown, blue, and green/yellow primary wires from the line filter. (See Figure 5-1 on page 5-4.)
2. Disconnect the green/yellow ground wire from the chassis, using a $^{5}/_{16}$ inch nutdriver. (See Figure 5-1 on page 5-4.)
3. Disconnect the power cable from J14 on the Main board.
4. From outside the instrument, remove the four T10 screws securing the power supply assembly to the chassis. When reinstalling, torque these screws to 8 in/lb.
5. Lift the power supply out of the chassis.
6. Disconnect the line filter cable from J1 on the power supply.
7. Disconnect the power cable from J2 on the power supply.

8. Remove the two T15 screws securing the power supply to the shield. When reinstalling, torque these screws to 8 in/lb.
9. Lift the power supply out of the shield.

Fan Assembly

Remove the fan and baffle as a unit.

1. From outside the instrument, remove the one T10 screw on each side of the instrument that secures the baffle to the chassis. When reinstalling, torque these screws to 8 in/lb.
2. Use long nose pliers to compress the lock tab on the connector, and disconnect the fan power cable from J890 on the Main board. (See Figure 4-2 on page 4-20.)
3. Lift the baffle out of the instrument.
4. When replacing the fan and baffle, make sure that the guide pins and slots line up correctly, top and bottom.

Front Panel/LCD Assembly

Remove the front panel and LCD assembly as a unit. For additional clearance you may remove the Fan assembly first.

1. Remove the six T10 screws that secure the front panel assembly to the chassis, two on each side and two on the bottom. When reinstalling, torque these screws to 8 in/lb.
2. Pull the front panel assembly forward, being careful of the Main board extension containing the headphone and USB connectors, until they clear the LCD bracket.
3. Disconnect the cables connecting the Front panel/LCD assembly to the Main board at J17, J18, and J29. (See Figure 4-2 on page 4-20.)

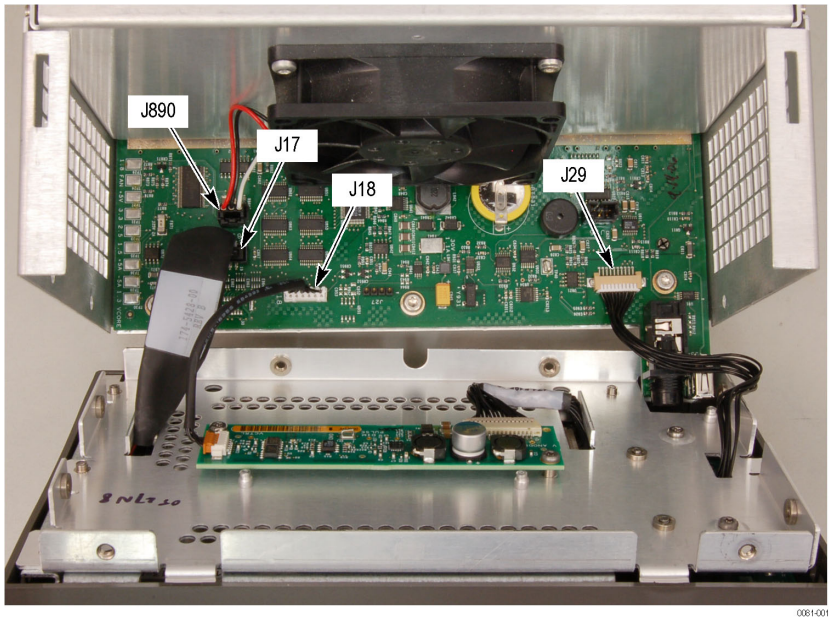


Figure 4-2: Front panel cable connections

Remove the bezel from the LCD assembly.

4. Remove the two T10 screws securing the bezel to the Front Panel board. (See Figure 4-3 on page 4-21.) When reinstalling, torque these screws to 8 in/lb.
5. Remove the two P1 Pozidriv screws securing the bottom of the bezel to the display bracket. When reinstalling, torque these screws to 4 in/lb.
6. Use a spudger or other tool to pry the bezel clips away from the bracket and then pull the bezel away, leading the front panel cable through the cutout in the bracket.

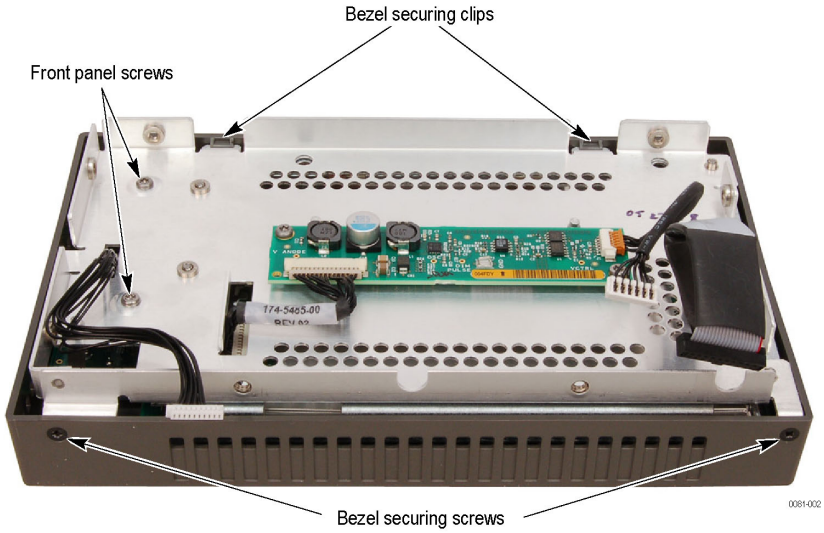


Figure 4-3: Front panel disassembly

LCD backlight. You must partially disassemble the LCD assembly to change the backlights.

There are two backlights. One is located at the top of the LCD assembly and one is located at the bottom of the LCD assembly. Each can be accessed from its respective corner of the assembly. Perform the following procedures to remove the backlights.

1. Remove the six screws attaching the LCD assembly to the display bracket. You will have to push the poron gasket aside with the screwdriver to access the screws. When reinstalling, torque these screws to 5.5 in/lb.
2. Separate the LCD assembly and the display bracket, and lay the LCD assembly face down on a soft, static-free surface.
3. Remove the two screws attached to the right-hand bracket of the LCD display assembly. The right-hand bracket is on the right when the assembly is facing you as shown. (See Figure 4-4.) When reinstalling, torque these screws to 1.0 in/lb.

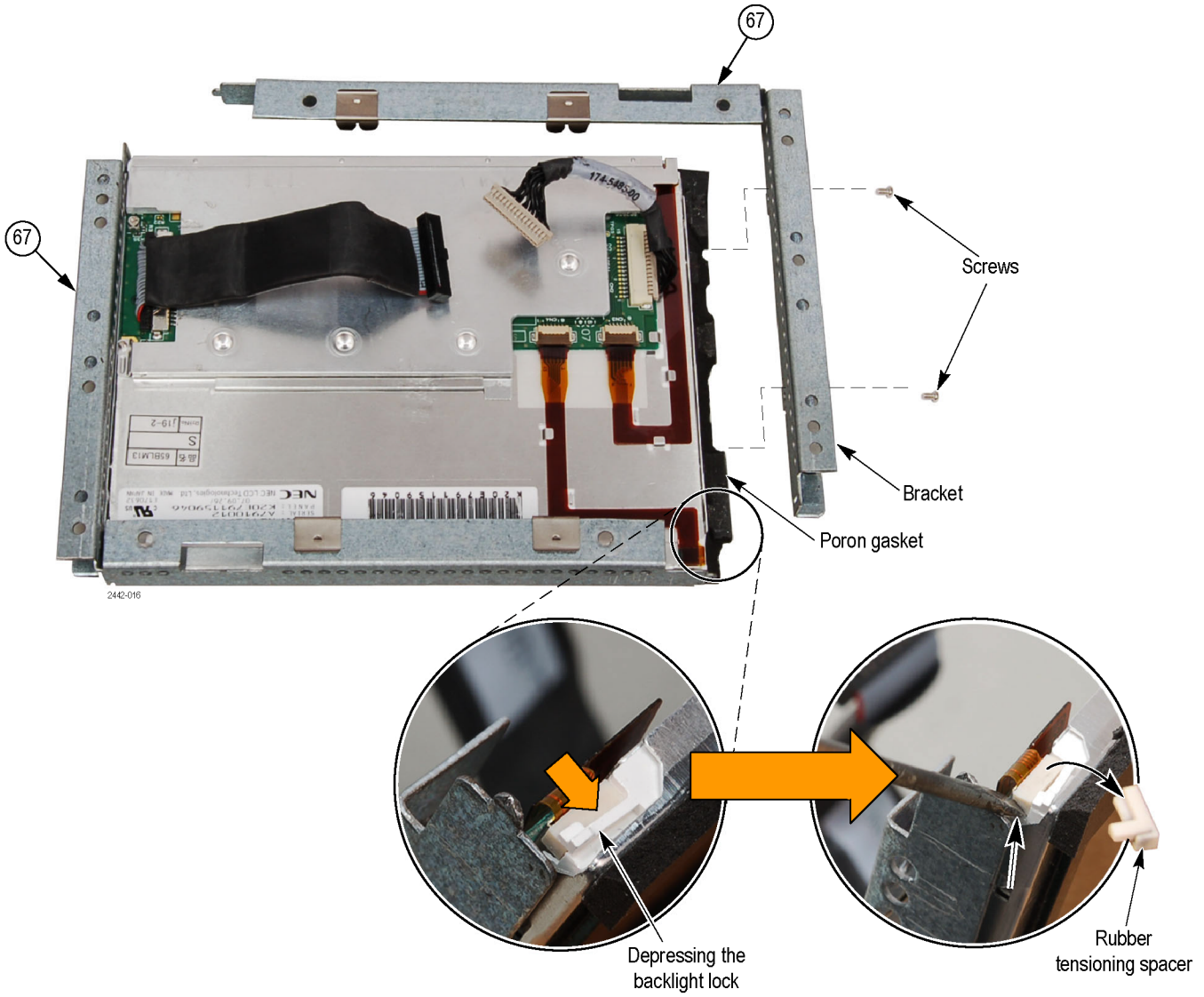


Figure 4-4: LCD assembly bracket and backlight lock

4. Gently separate the poron gasket from the bracket and remove the bracket.

5. While depressing the small white plastic backlight lock (located on the corner of the assembly), remove the rubber tensioning spacer using a thin object.

CAUTION. *To prevent damage, do not bend the flex circuitry. Carefully remove the flex circuit from the metal guides and connector latch.*

6. Lift up on the flex circuit connector latch and remove the flex circuit from the connector. (See Figure 4-5.)

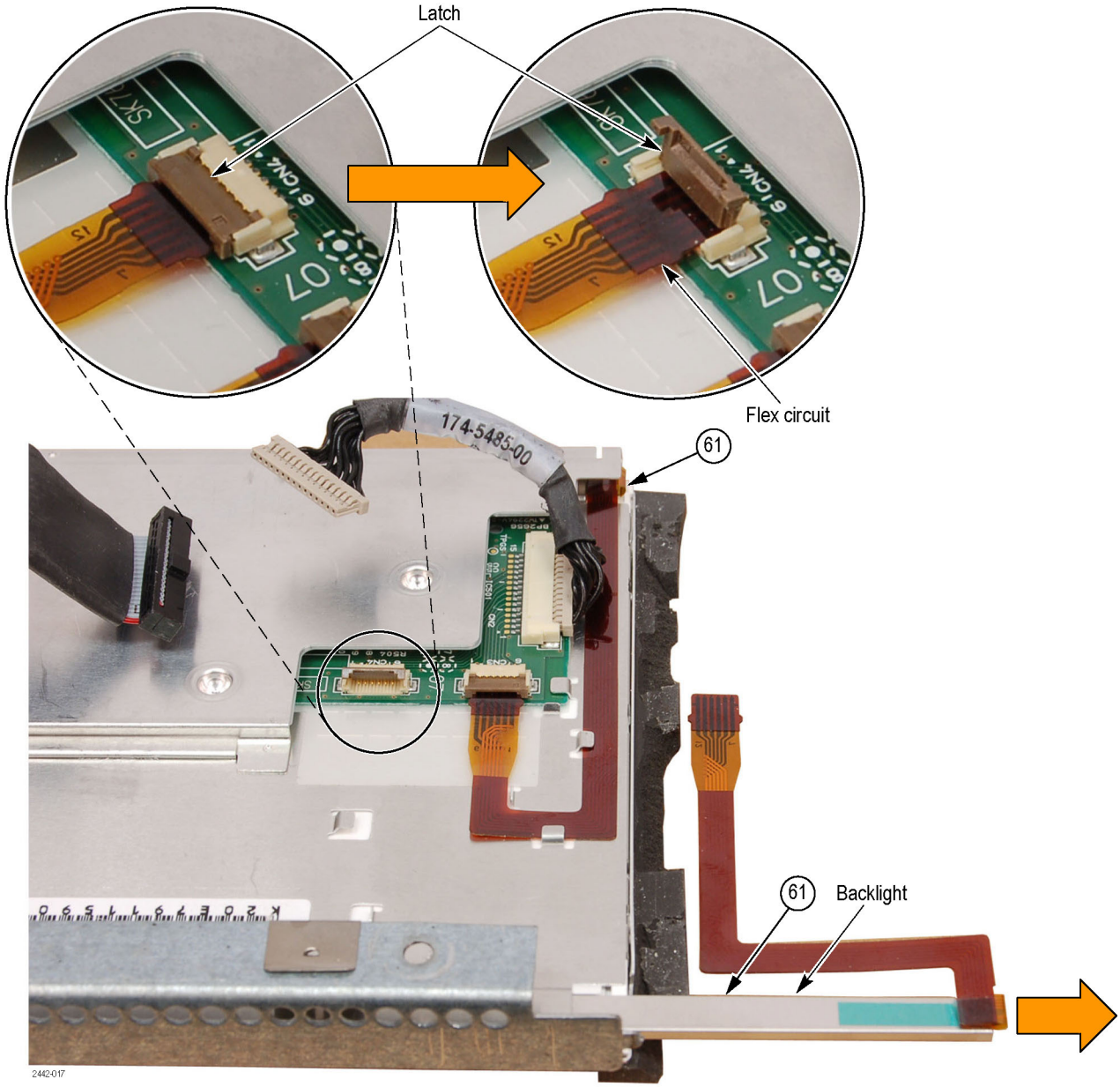


Figure 4-5: Backlight removal

7. Carefully remove the flex circuit from the metal guides.
8. Pull the backlight straight out (to the right) from the assembly.
9. To remove the other backlight, repeat the previous four steps.

Repackaging Instructions

This section contains the information needed to repackage the waveform monitor for shipment or storage.

Packaging

When repacking the instrument for shipment, use the original packaging. If the packaging is unavailable or unfit for use, contact your local Tektronix representative to obtain new packaging. Refer to *Contacting Tektronix* on the back of the Title page for the mailing address, the email address, and phone number.

Seal the shipping carton with an industrial stapler or strapping tape.

Shipping to the Service Center

Contact the Service Center to get an RMA (Return Material Authorization) number, and any return or shipping information you may need.

If the instrument is being shipped to a Tektronix Service Center, enclose the following information:

- The RMA number.
- The owner's address.
- Name and phone number of a contact person.
- Type and serial number of the instrument.
- Reason for returning.
- A complete description of the service required.

Mark the address of the Tektronix Service Center and the return address on the shipping carton in two prominent locations.

Replaceable Parts

Replaceable Parts

This section contains a list of the replaceable modules for the 1741C Waveform Monitor. Use this list to identify and order replacement parts. Note that not all parts listed in this section are present on every model. The parts present will depend on the model and options installed.

Parts Ordering Information

Replacement parts are available through your local Tektronix field office or representative.

Changes to Tektronix products are sometimes made to accommodate improved components as they become available and to give you the benefit of the latest improvements. Therefore, when ordering parts, it is important to include the following information in your order:

- Part number
- Instrument type or model number
- Instrument serial number
- Instrument modification number, if applicable

If you order a part that has been replaced with a different or improved part, your local Tektronix field office or representative will contact you concerning any change in part number.

Module Servicing

Modules can be serviced by selecting one of the following three options. Contact your local Tektronix service center or representative for repair assistance.

Module Exchange. In some cases you may exchange your module for a remanufactured module. These modules cost significantly less than new modules and meet the same factory specifications. For more information about the module exchange program, call 1-800-833-9200. Outside North America, contact a Tektronix sales office or distributor; see the Tektronix Web site for a list of offices: www.tektronix.com.

Module Repair and Return. You may ship your module to us for repair, after which we will return it to you.

New Modules. You may purchase replacement modules in the same way as other replacement parts.

Using the Replaceable Parts Lists

This section contains lists of the mechanical and/or electrical components that are replaceable for the 1741C Waveform Monitor. Use this list to identify and order replacement parts. The following table describes each column in the parts list.

Parts list column descriptions.

Parts list column descriptions

Column	Column name	Description
1	Figure & index number	Items in this section are referenced by figure and index numbers to the illustrations that follow. Orderable modules show the figure number without an index number.
2	Tektronix part number	Use this part number when ordering replacement parts from Tektronix.
4	Qty	This indicates the quantity of parts used.
5	Name & description	An item name is separated from the description by a colon (:). Because of space limitations, an item name may sometimes appear as incomplete. Use the U.S. Federal Catalog handbook H6-1 for further item name identification.

Abbreviations

Abbreviations conform to American National Standard ANSI Y1.1-1972.

Table 5-1: Replaceable parts list (See Figure 5-1.)

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
5-1					Circuit Boards and Connectors
-1	870-0258-00			2	CIRCUIT BD ASSY; ANALOG COMPOSITE,389-3545-00 WIRED
-2	131-7881-00			1	CONN,IO; PCB,USB,SERIES A;FEMALE,RTANG ON EDGE,1 X 4, 2.5MM CTR,13.90 H X 2.0 TAIL,30 GOLD,W/BOARD RETENTION
-3	870-0337-00			1	CIRCUIT BD ASSY; DUAL CHANNEL MAIN, 389395500 WIRED
-4	119-6801-01			1	POWER SUPPLY; 110W,AC-DC,5VDC 22A OUT,90-264VAC 47-63HZ IN,PFC,75% EFF,OPEN FRAME,6.5 X 3 X 1.26 IN,UL,CSA,VDE,SAFETY CONTROLLED
-5	337-4342-00			1	SHIELD, POWER SUPPLY; .050 AL, 5052-H32, MILL FINISH;
-6	174-4769-00			1	CA ASSY,SP; HV,BR,15.00 L & 4.00 L;CONN EACH END;LINE FILTER TO PWR SUPPLY,SAFETY CONTROLLED
-7	441-2525-00			1	CHASSIS,MAIN; 0.050 AL,SAFETY CONTROLLED
-8	134-0246-00			3	PLUG,HOLE COVER; BUTTON PLUG,;0.578 HEAD DIA X 0.406 THK,ACCOM 0.5 DIA HOLE,0.015-0.125 THK PNL,NYLON,BLACK,94V-2;
-9	211-0722-00			2	SCREW,MACHINE; 6-32 X 0.250,PNH,STL,CDPL,T-15 TORX DR (USED WITH WFM7F02 PORTABLE CASE ONLY)
-10	210-0457-00			1	NUT,PL,ASSEM WA; 6-32 X 0.312,STL CD PL,W/LOCKWASHER
-11	211-0410-00			2	SCR,ASSEM WSHR; 4-40 X 0.437,PNH,STL,CDPL,T-10 TORX DR
-12	131-4131-00			1	CONN,PLUG,ELEC; MALE W/LOCKING ADPTR,EXT MTG,SAFETY CONTROLLED
-13	211-0734-00			4	SCREW,MACHINE; 6-32 X 0.250,FLH100,STL,CDPL,T-10 TORX DR

Table 5-1: Replaceable parts list (See Figure 5-1.) (cont.)

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
-14	119-7086-00			1	FILTER,EMI; AC LINE CONNECTOR/INPUT FILTER;6.0A,120-250VAC,DC-400 HZ,2.2 NF CY,100 NF CX,IEC INPUT,FAST-ON/SOLDER LUG OUTPUT, CHASSIS MOUNT,SAFETY CONTROLLED;FN9222-6/06
-15	211-0722-00			2	SCREW,MACHINE; 6-32 X 0.250,PNH,STL,CDPL,T-15 TORX DR
-16	174-5030-00			1	CABLE ASSEMBLY; POWER: PWR SUPPLY TO MAIN BD
-17	220-0497-00			2	NUT,PLAIN,HEX; 0.5-28 X 0.562 HEX,BRS CD PL
-18	210-1039-00			2	WASHER,LOCK; 0.521 ID,INT,0.025 THK,SST
-19	214-3903-00			6	SCREW,JACK; 4-40 X 0.312 LONG,0.188 H HEX HEAD STAND OFF,4-40 INT THD, X 0.312 THD EXT 4-40
-20	131-7582-00			1	CONN,DSUB; PCB;FEMALE,RTANG,DUAL STACKED,15 POS HD LOWER,9 POS UPPER,SAFETY CONTROLLED
-21	131-7257-00			1	CONN,JACK; PCB/PNL,RJ45,CAT5,W/LEDS YELLOW & GREEN,FEMALE,RTANG,8 POS,0.1 CTR,0.528 H X 0.138 TAIL,10/100 BASE TX AND RX MAGNETICS MODULE,SAFETY CONTROLLED
-22	131-5450-00			1	CONN,DSUB; PCB,HIGH DENSITY;FEMALE,RTANG,15 POS,0.078 CTR,0.350 MLG X 0.125 TAIL,4-40 THD INSERT,BD RETENTION,30 GOLD,SAFETY CONTROLLED
-23	131-3378-00			2	CONN,RF,JACK; BNC,50 OHM,FEMALE,RTANG,PCB/REAR PNL,0.5-28 THD,0.625 H X 0.187 TAIL,W/O MTG FLANGE,W/MTG POSTS,METAL BODY
-24	211-0722-00			10	SCREW,MACHINE; 6-32 X 0.250,PNH,STL,CDPL,T-15 TORX DR
-25	211-0722-00			6	SCREW,MACHINE; 6-32 X 0.250,PNH,STL,CDPL,T-15 TORX DR
-26	220-0497-00			8	NUT,PLAIN,HEX; 0.5-28 X 0.562 HEX,BRS CD PL
-27	210-1039-00			8	WASHER,LOCK; 0.521 ID,INT,0.025 THK,SST
-28	333-4578-00			1	REAR PANEL, SAFETY CONTROLLED, 1741C
-29	131-3378-00			8	CONN,RF,JACK; BNC,50 OHM,FEMALE,RTANG,PCB/REAR PNL,0.5-28 THD,0.625 H X 0.187 TAIL,W/O MTG FLANGE,W/MTG POSTS,METAL BODY

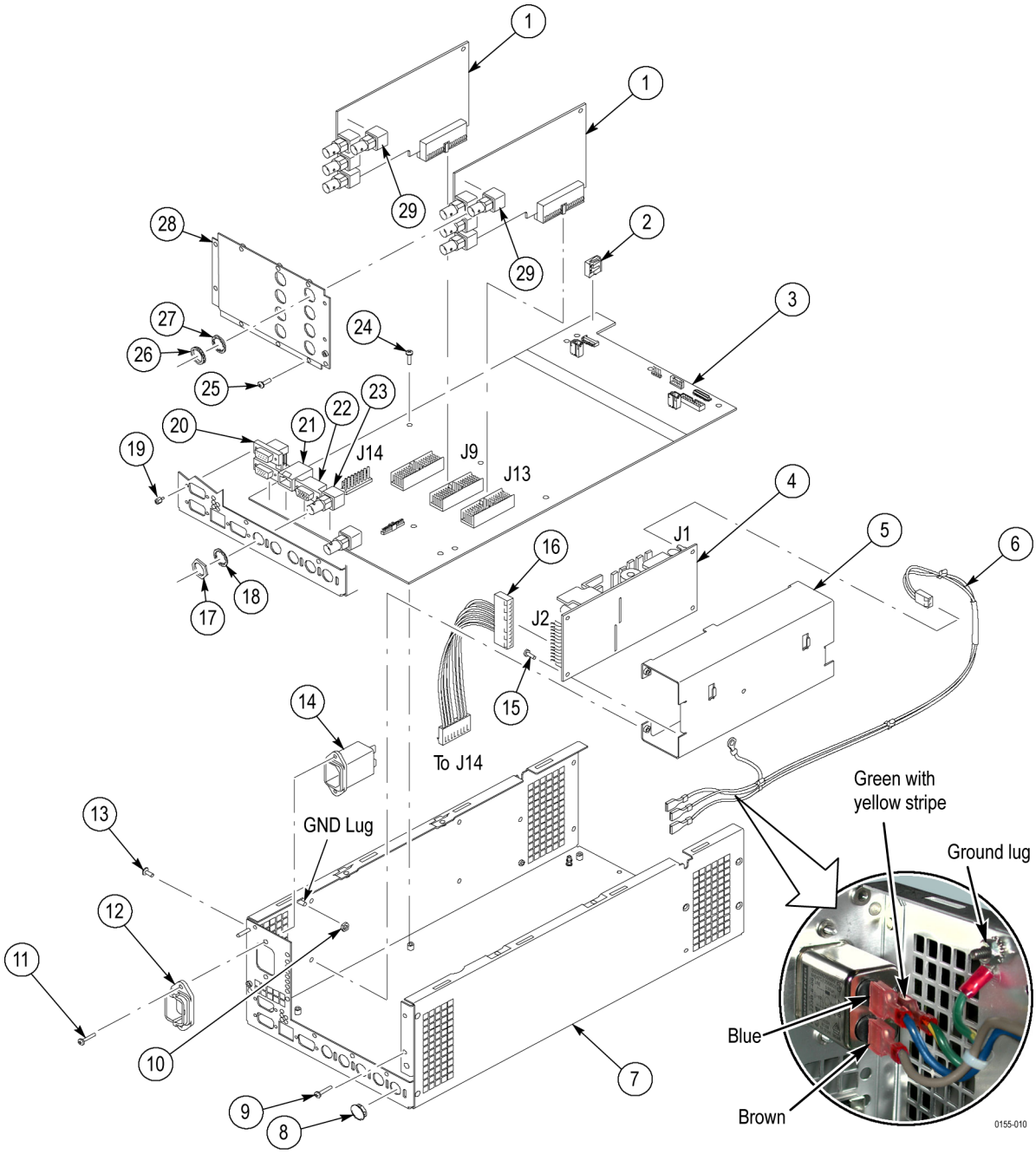


Figure 5-1: Circuit boards and connectors

Table 5-2: Chassis components (See Figure 5-2.)

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
5-2					**Chassis Components**
-1	200-4911-00			1	COVER, TOP CHASSIS; SAFETY CONTROLLED
-2	386-7435-00			2	SUPPORT, CIRCUIT BOARD
-3	211-0734-00			18	SCREW,MACHINE; 6-32 X 0.250,FLH100,STL,CDPL,T-10 TORX DR
-4	211-1117-00			2	SCREW,MACHINE; 4-40 X 0.187,PAN HEAD,STL,CD PL,T-10,TORX DR
-5	870-0186-00			1	LED BACKLIGHT DRIVER
-6	211-1117-00			2	SCREW,MACHINE; 4-40 X 0.187,PAN HEAD,STL,CD PL,T-10,TORX DR
-7	407-5314-00			1	BRACKET; DISPLAY MOUNTING,FRONT,SAFETY CONTROLLED
-8	150-0335-00			2	LAMP; BACKLIGHT ASSY, LED, REPLACEMENT FOR 119743900 6.5 LCD DISPLAY
-9	850-0097-00			1	FRONT PANEL ASSY; MODULE; 1741C, TESTED
-10	129-1636-00			2	SPACER POST: 4-40M/F,0.687L,SST,0.188HEX
-11	174-5492-00			1	CABLE ASSEMBLY, 10 PIN; FP TO MAIN
-12	863-0262-00			1	CIRCUIT BD SUBASSY;389410200;FP;ROHS COMPLIANT
-13	311-2580-00			2	PB-FREE;ENCODER; DIGITAL CONTACTING ENCODER, 24 CPR, NON-DETENTED, 6 MM DIA SHAFT, 17.5 MM LENGTH SHAFT
-14	260-2882-00			1	SWITCH, KEYPAD, ELASTOMERIC,1741C
-15	426-2631-00			1	FRAME; FRONT BEZEL,PC/ABS,TV GRAY,SAFETY CONTROLLED
-16	211-0119-00			2	SCREW, MACHINE; 4-40 X 0.25, FLH, 100 DEG, STL BK OXD POZ
-17	335-2046-00			1	LABEL, FRONT PANEL, LEXAN, 1741C
-18	366-0859-01			3	ASSEMBLY, KNOB; .470 DIAMETER, SOFT TOUCH
-19	335-2047-00			1	LABEL, MARKER, IDENTIFICATION, LEXAN,1741C; SAFETY CONTROLLED
-20	311-2607-00			1	ENCODER; DIGITAL CONTACTING ENCODER, 24 CPR, 24 DETENTS, 6 MM DIA SHAFT, 17.5 MM LENGTH SHAFT, 12 MM BODY SIZE, TOP MOUNT; RE0123
-21	850-0098-00			1	LCD ASSEMBLY, 1741C
-22	211-1117-00			6	SCREW,MACHINE; 4-40X0.500,PAN HEAD,T-10 TORX,CD PL
-23	337-4419-00			1	PORON FOAM SHIELD
-24	850-0059-00			1	LCD DISPLAY MODULE; TESTED
					****INCLUDED PARTS****
	119-7439-00			1	DISPLAY MODULE; LCD, COLOR;1024X768 (XGA), 6.3 DIAG
					Attached Parts
	337–4421–00			1	SHIELD,DISPLAY; 5.568 X 4.221,0.090 THICK, 0.043 THICK GLASS,0.021 THICK BLACK PORON
					End Attached Parts
	131-6521-00			4	CONTACT, ELEC; EMI, CLIP-ON, 0.38 L X 0.460 W (2 CONTACTS) X 0.45 HIGH, ELECTROLESS NICKEL PLATE
	211-0950-00			4	SCREW, MACHINE; M2X.4X3L, PHL, PNH, STEEL, ZINC FINISH
	174-5428-00			1	CA ASSY; SHIELDED RIBBON ADAPTER TO XGA LVDS LCD DISPLAY, 20 PIN, 4IN
	174-5485-00			1	CABLE ASSEMBLY DISPLAY INVERTER;15 PIN;LED BACKLIGHT TO DISPLAY
	337-4419-00			1	PORON FOAM SHIELD
	407-5303–00			2	BRACKET, CRADLE, WFM
					****END INCLUDED PARTS****
-25	174-5428-00			1	CA ASSY; SHIELDED RIBBON ADAPTER TO XGA LCD DISPLAY, 20 PIN
-26	174-5493-00			1	CABLE ASSY, SP; DISCRETE, MAIN BD TO BACKLIGHT DRIVER
-27	119-6554-00			1	FAN ASSEMBLY; 12V;0.11A,1.3W,28CFM, 2450RPM,27DBA,80MM SQ X 20MM);6 IN,3 LEAD WITH CONN, UL,CSA,VDE,SAFETY CONTROLLED

Table 5-2: Chassis components (See Figure 5-2.) (cont.)

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
-28	211-1050-00			4	SCREW,MACHINE; 6-32 X 0.312 L,PNH,STL CAD PLT,T15
-29	131-6521-00			3	CONTACT,ELEC; EMI,CLIP-ON,0.38 L X 0.500 W (2 CONTACTS) X 0.45 H,ELECTROLESS NICKEL PLATE
-30	407-4999-00			1	BRACKET; FAN MOUNTING,0.050 AL,SAFETY CONTROLLED

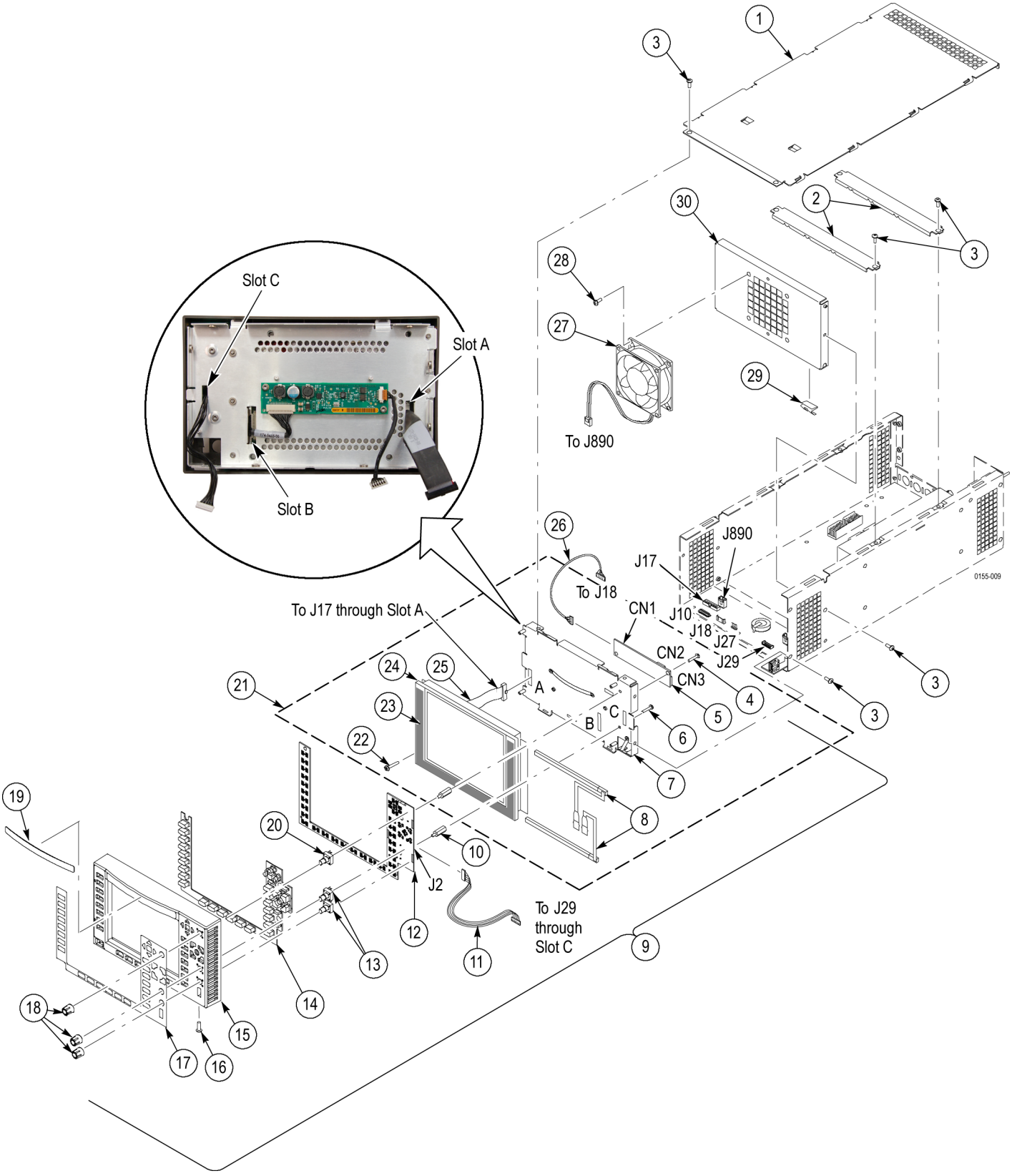


Figure 5-2: Chassis components

Table 5-3: Replaceable parts list (See Figure 5-3.)

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
5-3					**Main Board**
-1	159-5022-00			7	FUSE; 5.0A,125V;FAST BLOW,0.1 X 0.1 X 0.24,UL REG,CSA CERT;451005,SAFETY CONTROLLED
-2	260-5015-00			1	SWITCH, PUSH; SPST, TACT;50MA, 50V, MOMENTARY, SILVER CONTACTS;KSC221G, GULLWING SMD
-3	159-5018-00			1	FUSE; 3.0A,125V,FAST BLOW,0.1 X 0.1 X 0.24,UL REG,CSA CERT,SAFETY CONTROLLED
-4	146-0109-00			1	BATTERY,DRY; 3.0V,LITHIUM MANGANESE DIOXIDE,210MAH,20 X 3.22MM COIN CELL WITH SOLDER TABS,CR2032-1HF1
-5	119-5660-00			1	TRANSDUCER; PIEZOELECTRIC,AUDIO;IN 3 TO 25V P-P,OUT 70DB AT 10CM AT 3V P-P, FREQ 3.5-5.5KHZ,PKG DIA 13 MM X 7.8 MM H,5.0MM PIN SPACING,NOT MACHINE WASHABLE;PKM13EPY-4000-TF01
-6	159-5003-00			1	FUSE,THRM,CHIP; SELF RESETTING FUSE,1.1A HOLD,2.2A TRIP AT 20 DEG C,30V MAX,SAFETY CONTROLLED
-7	159-5014-00			1	FUSE; 2.0A,125V,FAST BLOW,0.1 X 0.1 X 0.24,UL REG,CSA CERT,SAFETY CONTROLLED

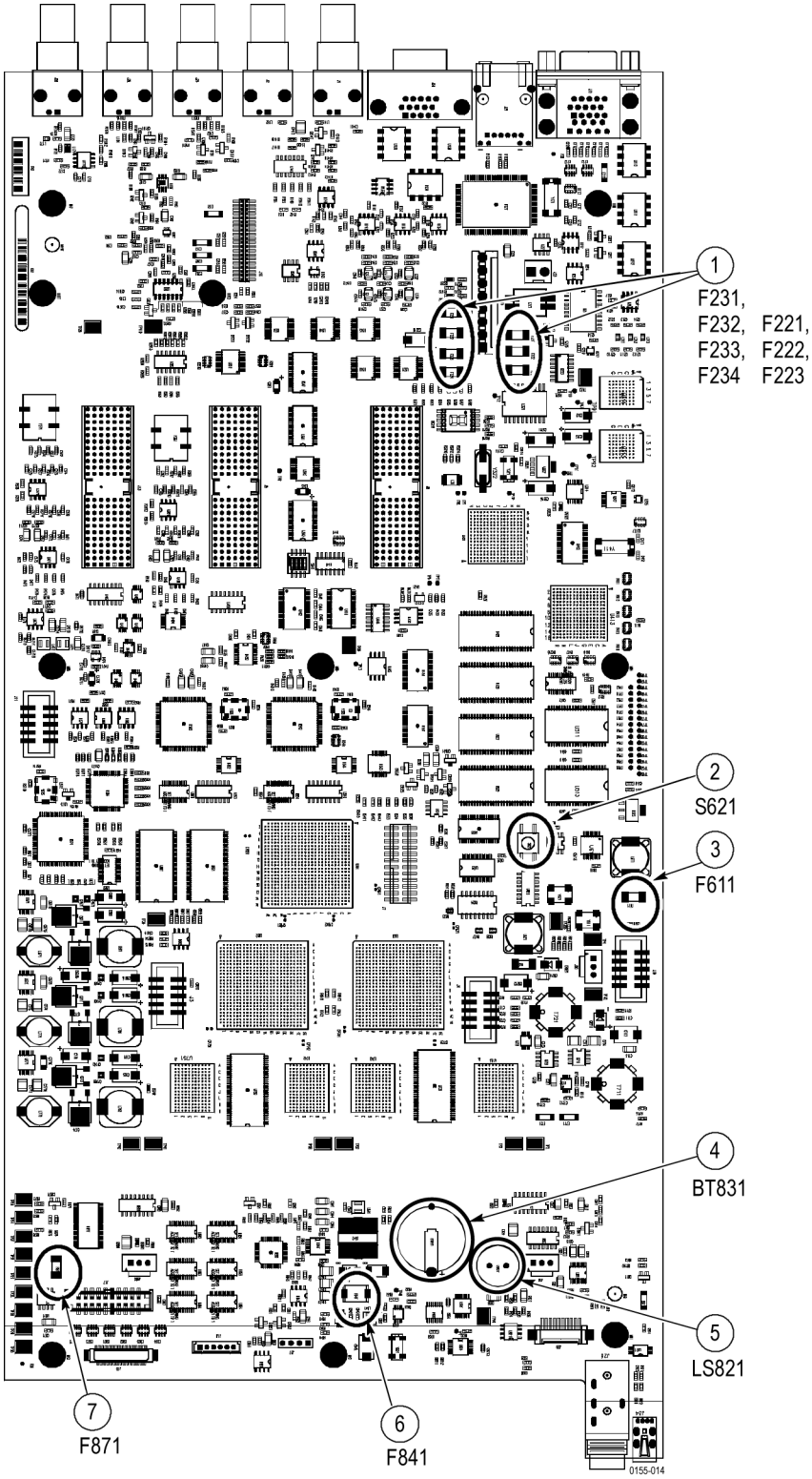


Figure 5-3: Main board replaceable components

Table 5-4: Replaceable parts list

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description		
					Standard Accessories		
	071-2584-xx			1	QUICK START REFERENCE, 1741C		
	063-4185-xx			1	DOCUMENTATION CD, 1741C		
	071-2626-xx			1	USER MANUAL, TECH, ENGLISH, 1741C		
	071-2627-xx			1	USER MANUAL, TECH, S. CHINESE,1741C		
	See Description			1	CABLE ASSY, POWER:		
					Option	*Country*	*P/N*
					A0	N. AMERICA	161-0066-00
					A1	UNIV EURO	161-0066-09
					A2	UK	161-0066-10
					A3	AUSTRALIA	161-0066-13
					A4	USA 240V	161-0066-12
					A5	SWITZERLAND	161-0154-00
					A6	JAPAN	161-A008-00
					A10	CHINA	161-0304-00
					A11	INDIA	161-0400-00
					Optional Accessories		
	WFM7F02				CABINET; PORTABLE CABINET WITH HANDLE,FEET,TILT BAIL AND FRONT PANEL COVER		
	200-4716-00				COVER,FRONT; PROTECTIVE,PC/ABS FR110,TV GRAY		
	WFM7F05				RACK ADAPTER; DUAL SIDE BY SIDE		
	077-0155-xx				SERVICE MANUAL, PDF ONLY, 1741C		
	077-0152-xx				SPECIFICATIONS & PERFORMANCE, PDF ONLY, 1741C		

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